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Leading-edge technology firms present a special challenge to the organizational researcher; exacerbated when novel technologies comprise not just the firm's production output, but also the underlying infrastructure and intermediary outputs not directly linked to the firm's core revenue-generating model. In the information technology, communication, or consumer internet sectors, the firm must maintain and develop sophisticated and evolving capabilities only indirectly connected to the ultimate provision of goods and services into current and future markets.

In the case of pre-market ventures and organizations actively seeking new market opportunities, it is unclear whether the firm's specialized capabilities could be leveraged to identify, assess, and extract value from unfamiliar opportunities. Organizations could 'search' for technological solutions or opportunities (Gavetti & Levinthal, 2000; Levinthal, 1997; March, 1991; Rosenkopf & Nerkar, 2001). Whereas most of this rich literature has focused on outcomes of search as well as some organizational or individual attributes such as prior experience (Ahuja & Lampert, 2001; Shane, 2000), it is likely that structure of an organization's knowledge and capabilities could be an enabler or constraint on the nature of entrepreneurial opportunities perceived, assessed and exploited (George, Kotha & Zheng, 2008). As firms develop capabilities that may not be core to the firm's products, these capabilities or processes may also shape the markets or opportunities in which they engage. In this chapter, we suggest that firms 'intuit' (verb form of intuition) markets in the face of uncertainty, and that research is warranted to assess how firms could be structurally organized to gain value from such a capability.

To begin, we note two specific organizational forms in which *structured intuition* may play an important role. The biotech sector has been heavily studied in a variety of structural and capabilities-based frameworks; the nature of the business fascinates researchers, in part, because biotech firms operate at the leading edge of life science research, utilize vast sums of venture capital, and anticipate termination (preferably by acquisition) prior to profitability— a measure of success in this sector. The relevant characteristic of biotechnology firms, for our purposes, is the dependence on sophisticated technology throughout the organization: information systems for recording and sharing experimental data, wet lab equipment and supplies requiring extensive training and experience, and the ultimate products which include synthetic viruses and monoclonal antibodies, just as examples. In particular, many, if not most biotechnology companies must research and develop entirely new technologies that represent only enabling mechanisms or even just verification information regarding the ultimate product. For example, a variety of firms in the transgenic organism market developed retroviruses and genetically

modified organisms as enablers and demonstrations of the potential application of transgenic technology for therapeutic manufacturing processes.

In a second example, we consider the virtual structures utilized by many start-up firms in the Web 2.0 social networking space. These organizations, whether driven by a specific *cause* or by strictly financial goals, establish the infrastructure to support multi-modal communication within and between affinity-bound communities. In the end, these sites generally (plan to) generate revenues via linkages to commercial products, whether through traditional web-based advertising or by selling sociodemographic and utilization pattern data (among other mechanisms), but the technology capabilities and applications that make up the core functionality of the business reside in the communications infrastructure, often spanning multiple modalities (web, mobile, txt, ipod). In fact, the development of the communications infrastructure is a necessary but not sufficient mechanism to determine the firm's revenues because the infrastructure users are, for these firms, not the economic (paying) customers. In other words, even when the infrastructure is established, the firm may not know where or who the final economic market will be. Consequently, firms often develop capabilities that are not core to its business and yet may define how and what markets they would enter at a later point in time.

The role of structure

Woodward's seminal research linking technology to optimal organizational form presented a contingent theory of managerial structure that, in effect, presented the organizational version of scientific management. Taylorism addressed individual work processes; Woodward's theory addressed organizational structural processes; deviations from optimized processes or systems reduced effectiveness. The very nature of contingency theory, however, relies on the implicit assumption that the production technology of the organization is the primary mechanism by which the firm generates value. In the case of the biotechnology and social networking firms, the underlying production technology and organizational structure are intermediaries to value creation, not production technologies per se.

A critique of organization theory lies in its apparent inability to deal with *change*, such as technological evolution or discontinuity (Woodward, 1980); in addition, while firms may be organically or mechanistically structured to address environmental turbulence or stability (Donaldson, 2001), we have no obvious structural contingency when the market is simply unkown, rather than unstable. In particular, we want to avoid a purely "found" conception of opportunity development dependent entirely on alertness (Kirzner, 1997) and/or experience (Shane, 2000) without some element of mental processing. This disposition is based partly on recent data suggesting that certain types of firms have advantages in entering entirely new niches (George, Kotha and Zheng, 2008), but also because an extensive literature on strategic choice suggests that the process of enactment represents a critical step in the managerial decision-making process (Child, 1997). While presumption favors rationality in such enactment, it seems reasonable to consider whether decision-making in the face of significant uncertainty incorporates more than just stepwise rational analysis.

Clearly, there are potential applications for structural contingency theory in the entrepreneurial opportunity identification process exhibited in industry sectors with high technology-dependence

and process, but we have no theoretical mechanism to explain the decision process without reverting to randomness, alertness, or pure experience. If these were the key factors, then structural contingency should favor large organizations with extensive slack resources; as we'll discuss shortly, research doesn't support this conclusion (George, 2005; George, Kotha and Zheng, 2008).

Intuition

We propose the potential role of *intuition*[1] in opportunity recognition. First, we utilize the definition of intuition developed by Isenman (1997), which focuses on "information content… originally outside of consciousness and beyond voluntary recall, yet [with] the potential to impact thought or action significantly" (p. 397). Important distinctions should be drawn: first, that intuition is not *irrational,* but rather *arational.* Second, we focus on intuition as a *processing mode* and not as "source of *de novo* knowledge" (p. 401). The intuitive process, then, augments conscious thought by accessing the accelerated processing speeds and potentially untapped memory stores of the unconscious, providing two mechanisms for insight: first, identifying commonalities across distinct circumstances, and second, deep pattern identification otherwise hidden by superficial distinctions (p. 399).

Intuition must be distinguished from a number of related but distinct cognitive activities. Creativity is the ability to develop entirely new concepts, ideas, or possibilities, usually without any sort of judgment associated with whether the novelty has inherent value or not. Alternatively, improvisation is the process of "making it up as you go along," an active rather than reflective process (Miner & Moorman, 2000). We suggest that intuition may subtly inform creativity and directly impact improvisation. Intuition may be a filter for creativity and thus have a positive or negative impact on creative flow, depending on whether the preferred output is measured in "out of the box" characteristics or relevance to the desired goals. On the other hand, intuition likely plays a significant role in improvisation, since the process of improvising requires rapid decision-making with limited information and feedback; intuition could provide deeper processing and information retrieval than the actor perceives in real time.

It should be clear that intuition can play an important role in the strategic enactment of opportunities, in effect enhancing the simulation process utilized to assess likely outcomes. The manager, team, or organization assessing strategic choices, and, in particular, potential market developments and opportunities, draws on all of the classic characteristics of exploration: experience, knowledge, and intelligence. In some cases, however, the intuitive process in enabled, drawing upon deeper capabilities and information to create surface-level analogies and conclusions otherwise unavailable via the explicit base of data.

Data from the biotechnology sector suggests age-dependent effects on the relationships between number of "new to the firm" technical initiatives, or *branching*, as well as branching distance

[1] We do not distinguish between specified individual intuition and the resultant intuition attributed to the organization. The question of whether a firm can act "intuitively" deserves separate attention. Nevertheless, in entrepreneurial organizations, the separation from entrepreneur and firm becomes increasingly blurred.

from the firm's core, and impact on the firm's technical outcomes. For younger firms, the optimal number of branching is lower, with rapidly decreasing returns for more branching, but with higher relative impact. In addition, younger firms obtain higher impact on outcomes from higher-distant branching, suggesting that as firms age, their intuition about new opportunities is best applied to more familiar areas of technical expertise (George et al., 2008).

Implications

Ultimately, structural contingency theory argues that the fit between organizational structure and size, environment, and strategy affect performance (Donaldson, 2001). Woodward's original study of 100 mid-size manufacturing firms in South Essex could not easily have anticipated the type of environmental or strategic elements that characterize the biotechnology or Web 2.0 firm in 2008. The primary structural element in her study, span of managerial control, may not even be easily measurable in relatively small, virtually-operated firms commercializing social networking structures. The simplest explanation applying structural contingency resorts to the broad category of organic structure (Donaldson, 2001), but this conceptualization was designed to apply to firms with relatively well-defined production technologies in a turbulent environment. The addition of intuition to the set of capabilities relevant to the contingency framework offers one mechanism to help assess how firms obtain *fit* in an environment that cannot be classified as turbulent, because the market itself may still be indeterminate.

The implications of intuiting markets cover three broad areas of management. The first considers the role of intuition in identifying potential market opportunities; the second is the role of intuition in the assessment of implementation options; the third is the set of characteristics associated with organizational structure that would support the development and application of intuition as an organizational capability. We assess each of these implications, and then discuss potential future research.

The strategic exploration process is generally described as a feedback loop, in which evaluation, choice, and implementation lead to measurements of effectiveness and renewed evaluation in the new (environmental) context (Child, 1997). Although it could be argued that intuition is relevant in the strategic choice, our focus is on the process itself. The identification of market opportunities and the assessment of implementation options thus both occur in the evaluation stage of strategic exploration. The mechanisms and impact of intuition in these two processes are, however, distinct and noteworthy. In the case of intuiting markets in the evaluation process, we envisage organizations projecting forward to identify where markets may develop or align most closely with the firms existing or potential capabilities. This is, fundamentally, an exercise in prediction, in which pattern-seeking must consider both the broader market conditions as well as specific technological developments that might yield seemingly incongruous results. For example, in our book, Inventing Entrepreneurs (2008), we portray Professor Michael Stonebraker's start-up firm, INGRES. INGRES failed in its intuition that the development of the early relational database market would be determined by standardization, which occurred when IBM selected a competing Oracle technology.

The use of intuition in the implementation assessment process, however, requires the specific application of knowledge, experience, and percipience about the nature of the firm and its

potential to change direction towards a potentially vague or uncertain goal. Here intuition focuses internally: creating, enacting, and simulating implementation scenarios and projecting outcomes. At small and/or young firms, it is likely that these activities are embodied within one or only a few individuals, and the success of the intuitive processes heavily dependent on how effectively those individuals function within the strategic choice context. Anecdotal evidence from the popular press seems to suggest that few firms excel based on the extraordinary intuitive capacity of a unique individual: Jobs at Apple, Branson at Virgin, Buffett at Berkshire Hathaway. But these appear to be the exceptions rather than the rule.

The mechanisms by which organizational structure may support intuiting markets are the most interesting and the least well understood. The literatures on fostering creativity and improvisation within organizations are relatively new (Miner & Moorman, 2000; Im, 2004), and usually couched within the context of product innovation, rather than market assessment or prediction. Arguably, the development of capabilities that intuit markets would be equally or more valuable than the capabilities associated with product development, for example, because accurate market knowledge decreases *uncertainty* while effective product development can only decrease the *risk* of product failure *assuming* the market develops as expected.

The challenge for an organization may then not be bounded *rationality*, or information asymmetry, but bounded *knowability*. To summarize Donald Rumsfeld, the former US Defense Secretary, "we don't know what we don't know." The availability of information and the capabilities of management information systems continue to increase dramatically with improvements in data access, storage, and manipulation; while no single solution to so-called "information overload" exists, organizational structure is a critical determinant of its onset and impact (Eppler, 2004). In fact, it may present the only leverage point for management, because the other key factors (type of information, individual orientation and skills, tasks and processes, and IT deployment) may be partly or wholly fixed. In these scenarios, the differentiating factor, assuming that firms cannot access any one extraordinarily intuitive individual, may be the organizational structure that best leverages the intuitive capabilities of the firm.

This area of structural contingency theory, which links characteristics of the organization to the firm's ability to identify and target novel market opportunities, presents a range of potential future research topics across a spectrum of organizational and management fields. First, capabilities research tools should be applied to distinguish between intuition and absorptive capacity. Since most measures of absorptive capacity have focused on the firm's overall *experience* in a given market, it would be beneficial to clarify that intuiting markets presents a capability partly or entirely independent of experience. Within the strategy process field, deeper investigation into precisely when and how intuition is applied in the strategic choice process, and under what circumstances it is most effective, could directly impact our understanding of endogenously-driven corporate strategy decision-making.

Management researchers might benefit from prior or newly applied cognitive psychology research on the determinants of individual intuitive capacity— since early stage biotechnology firms tend to have founder and/or key scientists actively involved in management, there is likely a link between the mindset applied to the scientific process and the effective use of intuition (Isenman, 1997). Social network theory would seem to be a particularly attractive area of

research, as the organizational utilization of intuition would seem to incorporate interaction between individuals and groups, and the strength of the relevant ties between those individuals and groups may be closely associated with how intuitively derived observations and conclusions are disseminated, assessed, and selected.

Conclusions

The role of intuition in the strategic choice process, as an organizational capability potentially influenced by firm structure presents significant challenges to the management researcher. At the same time, our understanding of strategy process has benefited from analysis of other key socio-psychological functions, including power, authority, and creativity, as well as socio-psychological structures, such as the informal network. We have long known that organizational decision-making processes have rational, informational and procedural limitations. Assessing the role of intuition, specifically for the market assessment and development process, offers the potential to clarify "new-to-the-firm" opportunity assessment. Preliminary data suggests that organizational characteristics are correlated with the impact of niche entry and technological branching. We encourage further research into structured intuition as an important determinant of success for firms, especially in technology-intensive sectors.

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